A COMPARATIVE STUDY OF MAGNETIC AND ELECTRICAL PROPERTIES OF $BiFeO_3$ MUTIFERROIC CERAMICS SINTERED BY ELECTRIC FIELD ASSISTED-METHODS: SPARK PLASMA SINTERING AND FLASH SINTERING

Alejandro F. Manchón-Gordón, ICMSE CSIC-Universidad de Sevilla, Spain
Antonio Perejón, ICMSE CSIC-Universidad de Sevilla; Universidad de Sevilla, Spain
E. Gil-González, ICMSE CSIC-Universidad de Sevilla, Spain
Pedro E. Sánchez-Jiménez, ICMSE CSIC-Universidad de Sevilla; Universidad de Sevilla, Spain
Luis A. Pérez-Maqueda, ICMSE CSIC-Universidad de Sevilla, Spain

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Multiferroics are one class of unique functional materials that exhibit two or more ferroic orders, such as ferroelectricity, ferromagnetism and ferroelasticity. This class of materials have attracted considerable interest owing to the coexistence of at least two switchable states, which promises a wide range of applications in multifunctional devices. Despite being one of the most studied multiferroic ceramics, bismuth iron oxide, $BiFeO_3$, still attracts much attention from scientist worldwide due to its unique properties of co-existence of ferroelectricity and ferromagnetism [1]. In fact, in its bulk form, $BiFeO_3$ is a ferroelectric material with a theoretical saturated polarization as large as 90 μC/cm^2 and a relatively high Curie temperature T_C~1100 K [2].

In this work, we present the influence of the sintering process on the magnetic and the electrical properties of bulk $BiFeO_3$ prepared by mechanosynthesis and sintered by two field-assisted sintering techniques, FAST: spark plasma sintering and flash sintering. Magnetic measurements proved that a decrease in the particle size causes the appearance of a ferromagnetic hysteresis loop at 300 K and a significant enhancement of the magnetic parameters when the samples are compared with those of a $BiFeO_3$ specimen prepared by conventional methods. Magnetization curves of the specimens densified by FAST methodologies exhibit a phase transition around 250 K, which has not been previously detected in bulk $BiFeO_3$ systems by magnetometry measurements. The electrical properties were measured by impedance spectroscopy. The conductivity of the flash sintering specimens was nearly one order of magnitude lower than samples prepared by SPS [3].

REFERENCES

[1] J. Wu, Z. Fan, D. Xiao, J. Zhu, J. Wang, Multiferroic bismuth ferrite-based materials for multifunctional applications: Ceramic bulks, thin films and nanostructures, Progress in Materials Science 84 (2016) 335-402.
[2] F. Kubel, H. Schmid, Structure of a ferroelectric and ferroelastic monodomain crystal of the perovskite BiFeO3, Acta Crystallographica Section B 46(6) (1990) 698-702.
[3] L.A. Perez-Maqueda, E. Gil-Gonzalez, A. Perejon, J.M. Lebrun, P.E. Sanchez-Jimenez, R. Raj, Flash sintering of highly insulating nanostructured phase pure BiFeO3, Journal of the American Ceramic Society 100(8) (2017) 3365-3369.